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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
|-----------------|-------------|----------------------|---------------------|------------------|

10/589,003

08/10/2006

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1035-646

4549

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EXAMINER

LEE, JAE

ART UNIT

PAPER NUMBER

2895

MAIL DATE

DELIVERY MODE

04/02/2009

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |                                    |  |
|------------------------------|--------------------------------------|------------------------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/589,003 | <b>Applicant(s)</b><br>ITOH ET AL. |  |
|                              | <b>Examiner</b><br>JAE LEE           | <b>Art Unit</b><br>2895            |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 24 November 2008.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,4-8,10-12 and 16-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4-8,10-12 and 16-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/24/2008 has been entered.

### ***Response to Arguments***

2. Applicant's arguments filed 11/24/2008 have been fully considered but they are not persuasive.

Applicant contends that Yamada et al. discloses the arrangement adopting a ferroelectric crystal, which is different from a group I-VII semiconductor single crystal and that it would be extremely difficult to find out a condition to obtain a wholly unexpected effect from enormous numbers or parameters and experimental conditions. Examiner respectfully disagrees and submits that Yamada et al. is utilized in order to disclose that acceleration voltage range for the **electron gun** (emphasis added), regardless of what type of crystal thin film is being formed. Because Yamada et al. discloses the benefits of preventing breakdown of a growing film which can potentially destroy the device, one of ordinary skill would be expected to initially try and utilize the

Art Unit: 2895

electron gun with the claimed acceleration voltage range of Yamada et al. to yield the benefit that is taught.

3. Applicant's arguments with respect to claims 1, 4-8, 10-12, and 16-19 have been considered but are moot in view of the new ground(s) of rejection.

***Claim Rejections - 35 USC § 112***

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. **Claim 1** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim contains limitation "uniform planarity and crystallinity" which was not disclosed in the specification. Specification mentions "excellent" and "high" planarity and crystallinity but those aforementioned terms are not defined the same as "uniform". Therefore, examiner takes the claim as best interpreted, and as per the specification, and will assume that "uniform planarity and crystallinity" was intended to mean "high planarity and crystallinity". For purposes of examination, the examiner has taken the term "uniform" to mean "high".

6. **Claims 1, 4-8, 10-12, and 16-19** are rejected under 35 U.S.C. 103(a) as being unpatentable over Williams et al. in view of Yakshin et al. and further in view of Taniguchi et al. and further in view of Yamada et al.

With regards to **claim 1**, Williams et al. teaches a group I-VII semiconductor crystal thin film formed on a substrate made from ionic crystals,

The group I-VII semiconductor crystal thin film being formed on a buffer layer while a beam is irradiated on the group I-VII semiconductor crystal thin film, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal film; (see Experimental Procedure, ¶1, lines 13-16, buffer layer  $\text{CaF}_2$  serves as structural template, Results and Discussion, ¶2, lines 1-3)

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity (as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Art Unit: 2895

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).

In the same field of endeavor, Taniguchi et al. provides motivation for making the CuCl layer single crystal by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al. also does not teach the acceleration voltage HV of the electron beam is  $0(\text{kV}) < \text{HV} < 30(\text{kV})$ .

In the same field of endeavor, Yamada et al. teaches a process wherein the electron beam's acceleration voltage is 15kv, well within the range of 0 to 30 kv. Primarily, such a low amount of kv is used to prevent breakdown of the growing film which can potentially destroy the device (see col. 9, lines 47-56).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to utilize an electron beam with an acceleration voltage of 15 kv in order to prevent the breakdown of films as taught by Yamada et al.

Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 5**, the combination of Williams et al., Yashkin et al., and Taniguchi et al. teaches the group I-VII semiconductor single crystal thin film as set forth in **claim 1**, wherein:

A region formed while irradiating an electron beam thereon and a region formed while not irradiating the electron beam thereon are located different places when viewing the substrate in a direction vertical to its surface (see Yashkin et al., see ¶37, lines 1-5, 6-14, different techniques will deposit on different locations of the surface).

With regards to **claim 6**, the combination of Williams et al., Yashkin et al., and Taniguchi et al. teaches the group I-VII semiconductor single crystal thin film as set forth in **claim 1** being a CuCl thin film (see Williams et al., Experimental Procedure, lines 13-16).

With regards to **claim 7**, the combination of Williams et al., Yashkin et al., and Taniguchi et al. teaches the group I-VII semiconductor single crystal thin film as set forth in **claim 1** being a metal halide semiconductor thin film (see Williams et al., Experimental Procedure, lines 13-16).

With regards to **claim 8**, Williams et al. teaches a process for producing a group I-VII semiconductor crystal thin film on a substrate made from ionic single crystals, comprising:

forming a buffer layer on the substrate, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal thin film (see Results and Discussion, ¶2, lines 1-3; buffer layer  $\text{CaF}_2$  serves as structural template); and



Art Unit: 2895

forming, on the buffer layer, the group I-VII semiconductor crystal thin film, the group I-VII semiconductor thin film being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see Experimental Procedure, ¶1, lines 13-16).

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity (as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to utilize an electron beam evaporation since it allows the user to selectively control the energy contribution at every stage of the film growth.

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).

In the same field of endeavor, Taniguchi et al. provides the motivation for using single crystal film by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Art Unit: 2895

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

Williams et al. does not teach the single crystal thin film to be of single composition.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al. also does not teach the acceleration voltage HV of the electron beam is  $0(\text{kv}) < \text{HV} < 30(\text{kv})$ .

In the same field of endeavor, Yamada et al. teaches a process wherein the electron beam's acceleration voltage is 15kv, well within the range of 0 to 30 kv. Primarily, such a low amount of kv is used to prevent breakdown of the growing film which can potentially destroy the device (see col. 9, lines 47-56).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to utilize an electron beam with an acceleration voltage of 15 kv in order to prevent the breakdown of films as taught by Yamada et al. Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 10**, the combination of Williams et al., Yashkin et al., and Taniguchi et al. teaches the process as set forth in **claim 8**, comprising:

forming a layer of the group I-VII semiconductor single crystal thin film while irradiating an electron beam thereon; and

forming the rest of the group I-VII semiconductor single crystal thin film while not irradiating the electron beam thereon (see Yashkin et al., see ¶37, lines 1-5, 6-14).

Art Unit: 2895

With regards to **claim 11**, the combination of Williams et al., Yashkin et al., and Taniguchi et al. teaches the process as set forth in **claim 9**, wherein:

the layer formed while irradiating the electron beam thereon and the layer formed while not irradiating the electron beam thereon have film thicknesses that are decided in consideration of a film thickness of the group I-VII semiconductor single crystal thin film, which is the combination of the layer formed while irradiating the electron beam thereon and the layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5; layer can also be formed without electron beam such as sputtering and magnetron sputtering, see ¶37, lines 6-14, film thickness of entire thin film must be considered to determine the thicknesses of the individual layers).

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

With regards to **claims 4,12**, the combination of Williams et al., Yakshin et al., and Taniguchi et al. teaches the limitations of **claims 1,8** for the reasons above.

The combination, however, does not teach the group I-VII semiconductor single crystal thin film as set forth having a film thickness that allows an internal electric field to be resonance-increased.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum film thickness to allow an electric field to be resonance-increased (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 16**, Williams et al. teaches a group I-VII semiconductor crystal thin film formed on a substrate made from ionic crystals,

The group I-VII semiconductor crystal thin film being formed on a buffer layer while a beam is irradiated on the group I-VII semiconductor crystal thin film, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal film (see Experimental

Art Unit: 2895

Procedure, ¶1, lines 13-16, buffer layer  $\text{CaF}_2$  serves as structural template, Results and Discussion, ¶2, lines 1-3).

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity (as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).

In the same field of endeavor, Taniguchi et al. provides motivation for making the CuCl layer single crystal by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the

Art Unit: 2895

electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al., however, does not teach the filament current FI of the electron beam to be  $0(A) < FI < 5(A)$ .

In the same field of endeavor, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to understand that if the irradiation current was 1 mA as taught by Yamada et al. (see **claims 17,19**), then the filament current MUST be no greater than 1 mA since one of ordinary skill would recognize that the current of the filament must be no greater than the irradiation current of the device.

Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another

Art Unit: 2895

variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 17**, Williams et al. teaches a group I-VII semiconductor crystal thin film formed on a substrate made from ionic crystals,

The group I-VII semiconductor crystal thin film being formed on a buffer layer while a beam is irradiated on the group I-VII semiconductor crystal thin film, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal film (see Experimental Procedure, ¶1, lines 13-16, buffer layer  $\text{CaF}_2$  serves as structural template, Results and Discussion, ¶2, lines 1-3).

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity (as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).



Art Unit: 2895

In the same field of endeavor, Taniguchi et al. provides motivation for making the CuCl layer single crystal by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al. also does not teach the irradiation current HI of the electron beam to be  $0(\text{microA}) < HI \leq 150(\text{microA})$ .

In the same field of endeavor, Yamada et al. teaches how thermal degradation can occur when the irradiation current density is  $1 \text{ A/mm}^2$  or higher (see col. 9, lines 47-56).

Art Unit: 2895

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to use a electron beam wherein in a given  $1\text{ mm}^2$  of beam area, there is a 1 microA current in that  $1\text{ mm}^2$  of beam area since any irradiation current over  $1\text{ A/mm}^2$  will cause thermal degradation as taught by Yamada et al.

Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 18**, Williams et al. teaches a process for producing a group I-VII semiconductor crystal thin film on a substrate made from ionic single crystals, comprising:

forming a buffer layer on the substrate, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal thin film (see Results and Discussion, ¶2, lines 1-3; buffer layer  $\text{CaF}_2$  serves as structural template); and

Art Unit: 2895

forming, on the buffer layer, the group I-VII semiconductor crystal thin film, the group I-VII semiconductor thin film being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see Experimental Procedure, ¶1, lines 13-16).

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity (as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to utilize an electron beam evaporation since it allows the user to selectively control the energy contribution at every stage of the film growth.

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).

In the same field of endeavor, Taniguchi et al. provides the motivation for using single crystal film by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Art Unit: 2895

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

Williams et al. does not teach the single crystal thin film to be of single composition.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al., however, does not teach the filament current FI of the electron beam to be  $0(A) < FI < 5(A)$ .

In the same field of endeavor, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to understand that if the irradiation current was 1 mA as taught by Yamada et al. (see **claims 17,19**), then the filament current MUST be no greater than 1 mA since one of ordinary skill would

Art Unit: 2895

recognize that the current of the filament must be no greater than the irradiation current of the device.

Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

With regards to **claim 19**, Williams et al. teaches a process for producing a group I-VII semiconductor crystal thin film on a substrate made from ionic single crystals, comprising:

forming a buffer layer on the substrate, the buffer layer being for alleviating distortion caused due to a difference in lattice constant between the substrate and the group I-VII semiconductor crystal thin film (see Results and Discussion, ¶2, lines 1-3; buffer layer CaF<sub>2</sub> serves as structural template); and

forming, on the buffer layer, the group I-VII semiconductor crystal thin film, the group I-VII semiconductor thin film being a combination of a layer formed while

Art Unit: 2895

irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see Experimental Procedure, ¶1, lines 13-16).

And the group I-VII semiconductor single crystal thin film is of uniform planarity and crystallinity ((as per specification, "uniform" is defined as "high"; "high" is a relative term; such a group I-VII semiconductor single crystal thin film of Williams et al. has a "high" planarity and crystallinity).

Williams et al., however, does not teach the beam to be an electron beam.

In the same field of endeavor, Yakshin et al. teaches how electron beam evaporation allows the user to selectively control the energy contribution at every stage of the film growth (see ¶9, lines 6-7).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to utilize an electron beam evaporation since it allows the user to selectively control the energy contribution at every stage of the film growth.

Williams et al., however, teaches the semiconductor film to be single crystal (see Fig. 3).

In the same field of endeavor, Taniguchi et al. provides the motivation for using single crystal film by teaching how a single crystal structure will have better electron mobility than a polycrystalline crystal structure which would make the semiconductor film more effective in operation (see ¶7, lines 1-3).

Art Unit: 2895

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create single crystal semiconductor films since electron mobility would be greatly enhanced as compared to a polycrystalline structure.

Williams et al. does not teach the single crystal thin film to be of single composition.

In the same field of endeavor, Yakshin et al. teaches how a single crystal thin film being a thin film of single composition and being a combination of a layer formed while irradiating the electron beam thereon and a layer formed while not irradiating the electron beam thereon (see ¶37, lines 1-5, 6-14; see ¶9, lines 1-7, one of ordinary skill in the art would have known that a single film can be created with a single composition using electron beam evaporation if so desired).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to create a single film of a single composition while irradiating the electron beam and a layer while not irradiating the electron beam thereon since it has already been made known and demonstrated by Yakshin et al.

Williams et al. also does not teach the irradiation current  $I_I$  of the electron beam to be  $0(\mu\text{A}) < I_I \leq 150(\mu\text{A})$ .

In the same field of endeavor, Yamada et al. teaches how thermal degradation can occur when the irradiation current density is  $1 \text{ A/mm}^2$  or higher (see col. 9, lines 47-56).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to use a electron beam wherein in a given  $1 \text{ mm}^2$  of

Art Unit: 2895

beam area, there is a 1 microA current in that 1 mm<sup>2</sup> of beam area since any irradiation current over 1A/mm<sup>2</sup> will cause thermal degradation as taught by Yamada et al.

Williams et al. also does not teach the roughness to be in the order of 2 nm.

In the same field of endeavor, it would have been obvious to one of ordinary skill to determine the optimum roughness (see *In re Aller, Lacey, and Hall* (10 USPQ 233-237)). It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical (see *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ 2d 1934, 1936 (Fed. Cir. 1990)).

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAE LEE whose telephone number is (571)270-1224. The examiner can normally be reached on Monday - Friday, 7:30 a.m. - 5:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Richards can be reached on 571-272-1736. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Art Unit: 2895

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